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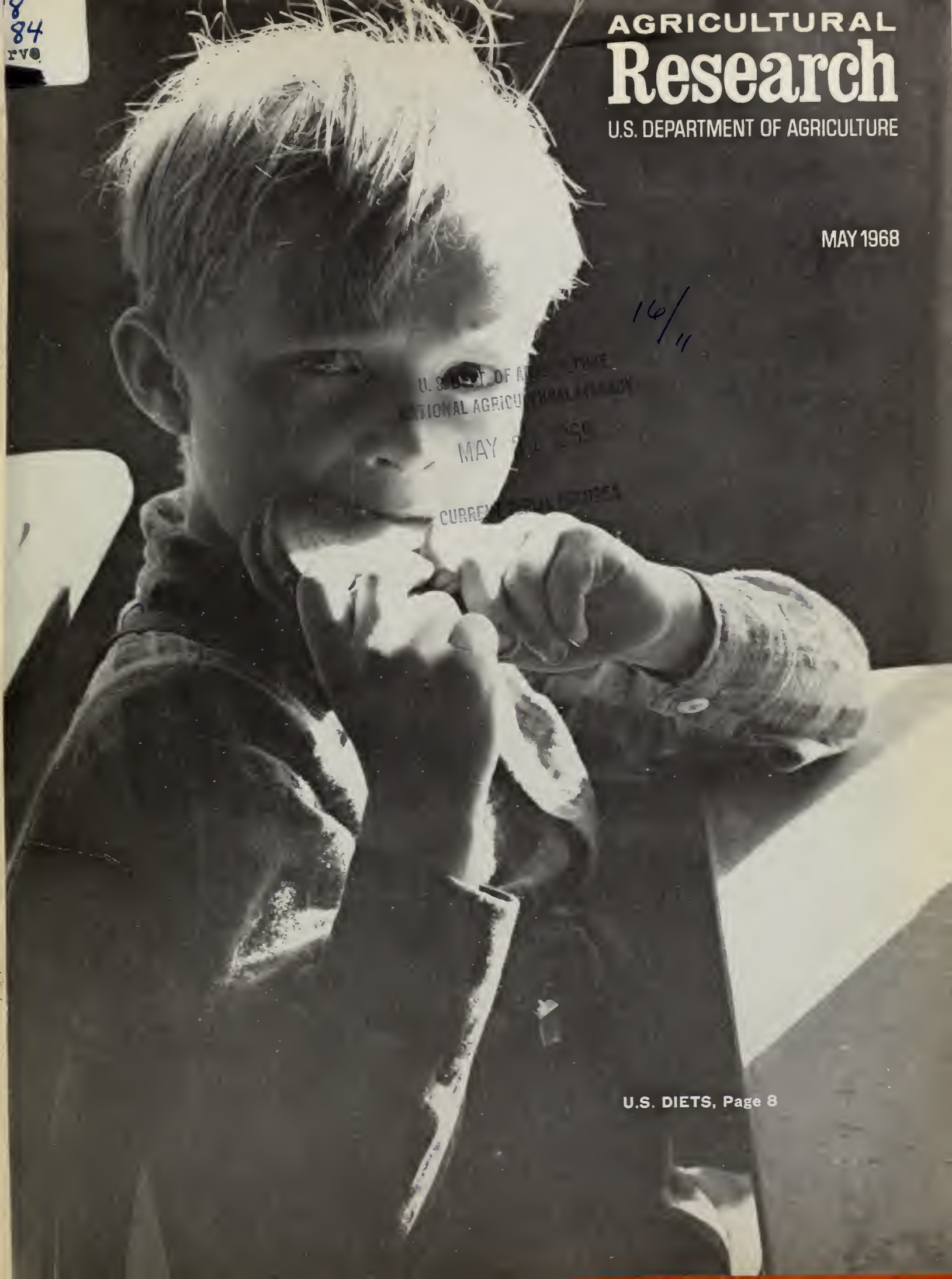

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Nutrition Education Program

An expanded nutrition education program now being set up by the Department will stress the need for better information to help guide homemakers in selecting the proper foods to buy in the interest of good nutrition.

Specifically, efforts will be directed toward encouraging increased use of milk and milk products and vegetables and fruits—this in view of the shortage of calcium, vitamin A, and ascorbic acid in U.S. diets revealed in a 1965 food consumption survey carried out by ARS (p. 8).

A decline in the number of good diets compared with 10 years ago and an accompanying increase in the number of poor diets during the same period indicates that many Americans are making a poor choice in their food purchases and that the dollars they spend may not be buying the best nutrition.

In addition to expansion of a number of education projects at Federal, State, and local levels, food purchasing standards for the school lunch and breakfast programs and other commodity distribution programs will be reviewed.

The Department is also asking milling and baking industries to step up the enrichment of flour and bakery products, and the possibility of enriching dried milk for domestic use will be studied.

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Orville L. Freeman, Secretary
U.S. Department of Agriculture

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HEAT TREATMENT PREVENTS

BEE DISEASE

INEXPENSIVE, easy to apply heat treatments may stem Nosema disease and wax moth attacks on honey bee colonies.

Nosema disease spores spread to succeeding bee generations that are exposed to infected hive equipment, combs, and to other bees from infected colonies. The disease organism is a protozoan parasite that interferes with digestion somewhat as dysentery does.

ARS entomologist G. E. Cantwell killed the disease organisms and moths by holding hive equipment and combs at 120° F. in a sterilizer similar to an oven. Entomologist Thor Lehnert, now stationed at Baton Rouge, La., participated in the Beltsville, Md., experiments.

The scientists discovered that Nosema organisms could be killed at temperatures significantly lower than those previously known to be effective. Research earlier in the century indicated that temperatures of 130° to 140° F. would be necessary—a condition that ruled out heat treatments because combs sag or melt at those temperatures. The 120° F. temperature used by Cantwell and Lehnert did not adversely affect combs or hive equipment.

Treatments killed Nosema organisms within 24 hours and killed all life stages of the greater wax moth in only 40 minutes.

To test the heat treatment under severe infection conditions, the entomologists first sprayed billions of disease spores onto hive frames—the part containing the combs. Then they placed heat-treated frames in the hives and added 3-pound packages of honey bees. To serve as checks they placed artifically infected but untreated equipment in other hives.

Bees in heat-treated hives remained virtually free of Nosema disease from mid-April, when placed in hives, through May when the most severe seasonal infections break out. In the same period, infections in untreated hives ranged up to 10 million Nosema spores per bee.

Beekeepers are presently limited in the number of available Nosema control measures. They mostly rely on adding antibiotics to a sugar sirup fed to bees when they are confined to their hives in cold weather. However, the antibiotic must be withdrawn in warm weather when bees begin producing honey.

Beekeepers presently combat wax moths with ethylene dibromide, a fumigant.

The experimental heat treatment has no time limitations for use, and involves no residue or odor problems. Although cost figures were not obtained, the scientists estimate that heat treatments would not exceed the cost of other control methods.

This summer, Cantwell and Lehnert will run tests with about 100 bee colonies. Canadian beekeepers will also participate, providing additional results under various field conditions. ■

Cantwell places beehive sections filled with combs in lab oven sterilizer (ST–3531–7).

New Oral Fowl Vaccine... From Killed Bacteria

A NEW ORAL VACCINE against fowl cholera brings closer to reality an entirely new weapon against dangerous bacterial diseases like diphtheria.

The experimental vaccine is of interest because it is prepared from killed bacteria, can be taken by mouth, and takes effect through an entirely new unknown mechanism. These qualities are important from four viewpoints:

- Current oral vaccines for man and animals require live organisms for effective protection—as with polio. Live organisms, however, present risk of accidental infection and may prevent eradication of the disease. A vaccine made from killed organisms avoids these dangers.
- Existing oral vaccines protect only against viruses; the new oral vaccine protects against bacteria.
- Present bacterial vaccines must be injected. The experimental oral vaccine may make it possible to bypass individual inoculation.
- Typically, vaccines work by stimulating production of antibodies in the blood stream to repel later disease attacks. Oral killed fowl cholera vaccine fails to stimulate production of antibodies detectable by the usual laboratory tests. Its mode of action differs from all known methods of disease protection and will be a major objective of future research.

Work on the experimental oral killed vaccine was conducted by ARS scientists K. L. Heddleston and P. A. Rebers at the National Animal Disease Laboratory, Ames, Iowa. Heddleston developed the current injected vaccine against fowl cholera; this experience led him to research on a killed vaccine that could be given by mouth.

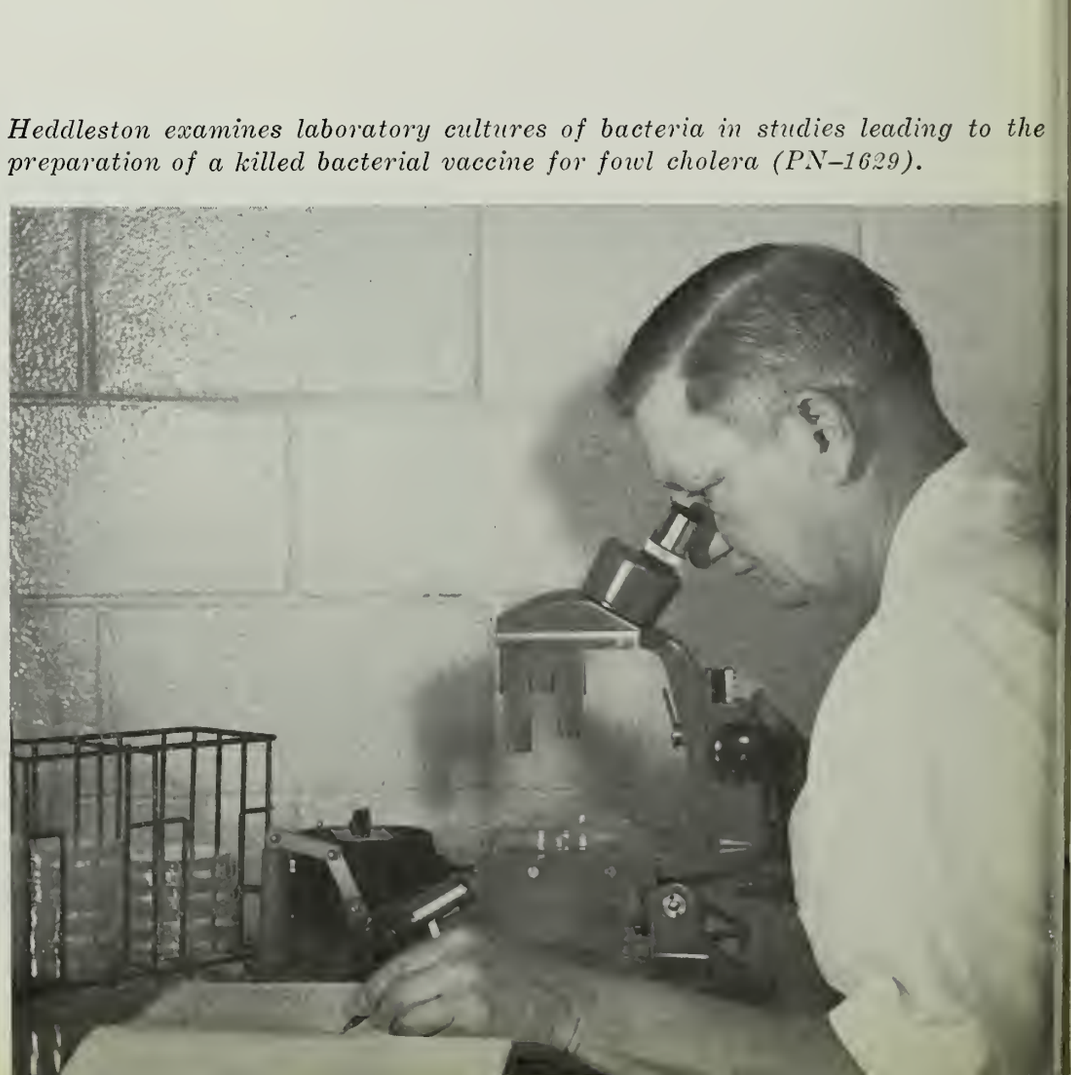
The scientists first checked the vaccine's effectiveness by injecting chickens and turkeys with a strong culture of active fowl cholera bacteria 10 to 14 days after the vaccine had a chance to take effect. In 10 experiments, the average survival of orally vaccinated chickens after disease exposure was 48 percent. Protection was at its highest, 79 percent, when chicks were treated in three stages: the day of hatch; then 1 and 2 weeks later.

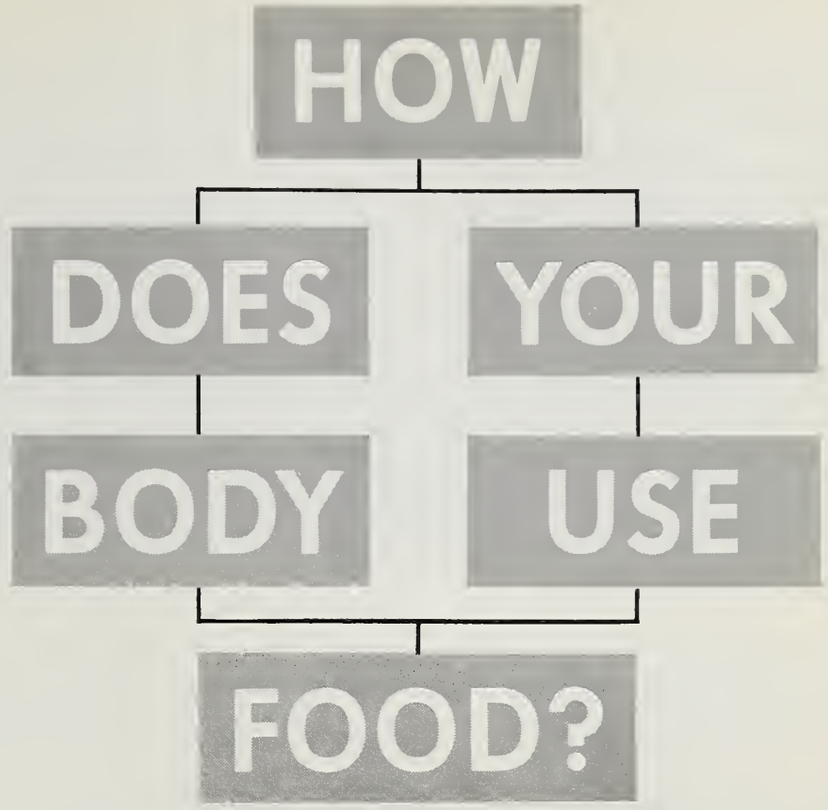
Five experiments with turkeys gave an average protection rate of 45 percent. Best results, 73 percent protection, occurred when poults were treated at 2, 3, and 4 weeks of age. In all cases oral vaccination required more treatments than conventional injected vaccination.

In initial tests with the oral vaccine, the researchers put it into the mouths of test birds with a dropper. Later they administered the vaccine in drinking water—a much more practical method for routine use, because it eliminates handling each bird individually.

Findings, however, are still preliminary. Heddleston and Rebers want to improve the oral vaccine's effectiveness by determining the proper age at which to treat the bird, the dosage, and the number of treatments and the intervals between them.■

Heddleston examines laboratory cultures of bacteria in studies leading to the preparation of a killed bacterial vaccine for fowl cholera (PN–1629).





WHAT PART DOES heredity play in the body's response to food?

The complete answer isn't available yet, but ARS research is making it increasingly evident that your parentage may have a good deal to do with the way your body uses food.

A recent study by research nutritionist N. W. Marshall of the ARS Experimental Nutrition Laboratory, Beltsville, Md., and biometrician R. P. Lehmann, formerly of ARS Biometrical Services, is a good example. Results of this experiment, in which 2 lines of rats were fed different kinds and levels of protein in their diets, indicate that kidney enlargement, occurrence of certain types of kidney degeneration (nephrosis), and excretion of abnormal amounts of urine protein (indicating kidney malfunction) may be due more to heredity than to the amount and kind of protein consumed.

The experiment was undertaken specifically to check on the response to level and type of protein diets by rats prone to develop nephrosis spontaneously.

The scientists selected two lines of laboratory rats which had been inbred to show significant differences in body size, food consumption, occurrence and degree of gross nephrosis, kidney stones, and urine protein excretion. Those with less nephrosis were labeled "Line 1," while those known to be prone to nephrosis were designated "Line 2."

Because abnormal kidney conditions in rats are somewhat similar to certain kidney diseases in humans, and rats often respond to diets in a manner similar to humans, research nutritionists say these animals make an excellent tool for studying the metabolic processes.

The protein source for both lines of rats was either lactalbumin or defatted whole egg which was fed in various combinations in an otherwise adequate diet. Both lines received the protein as defatted egg, while some of the Line 2 rats received the protein as lactalbumin. For almost every litter fed one protein combination, a litter from the same family received a standard rat diet.

When the inbred animals were about 300 days old, urine was collected from representative rats for several days followed by a complete evaluation of the entire group. Results showed that Line 1 rats on the defatted egg protein diet did not develop enlarged kidneys as did Line 2 rats fed the same diet. Thus, egg protein *per se* cannot be considered responsible for the enlarged kidneys.

Protein excretion by the Line 2 rats far exceeded amounts excreted by Line 1 rats, indicating that the difference in excretion of nephrosis-prone animals and apparently healthy rats was related less to diet than to heredity.

Rats fed the stock diet produced the most kidney stones, perhaps because of the high grain or high ash content of the diet, plus the added limestone. Apparently, both lines of rats had the genetic background which, when influenced by diet, could lead to production of kidney stones.

In addition, results indicate that diets with an intermediate level of protein may have a more protective effect with respect to kidney size and development of nephrosis in rats prone to nephrosis (Line 2) than diets high in protein.

The Line 2 nephrosis-prone rats excreted twice as much protein with all diets as the Line 1 rats. Animals of both lines on the stock diet excreted the most protein and those fed 24 percent of either defatted egg or lactalbumin, the least.

Results of the experiment clearly indicate that any interpretation of nutrition studies should be approached with caution because "hidden" genetic defects may be partially responsible for individual animal—or human—reactions to diet.■

NEW TECHNIQUE MAY HELP

PLANT BREEDERS

INDIAN SCIENTISTS have developed a new test tube plant fertilization method which could help overcome some of the causes of sexual incompatibility in plants.

This occurs in many species when the parent plant does not produce living seeds although it has functional gametes (sex cells).

Sexual incompatibility is a pre-fertilization barrier, when it occurs:

- during the germination of pollen grains on the stigma, the top of the female organ of a flower.
- during the growth of pollen tubes in the style, a narrow tube leading down from the stigma to the ovary.
- at the time of discharge of male gametes into the embryo sac.

To overcome this barrier, the scientists working at the University of Delhi, Delhi, under a 5-year Public Law 480 research grant, developed a technique for severing unfertilized ovules from the ovary and rearing them on an artificial medium with pollen. This eliminated the pistil tissues which can cause the pre-fertilization barriers of the parent plant.

In one set of experiments with the poppy family, pollen grains lodged on the ovules germinated within 15 minutes; those around the ovules germinated 1 hour later. In another group of experiments with the poppy, fertilization was completed within 2 or 3 days. During the first 4 days of culture, the fertilized ovules became swollen and opaque. In another 2 or 3 days they turned mealy white, a feature natural to fertilized poppy ovules developing into normal seeds. Growth of the vital endosperm, or nutritive tissue adjacent to the embryo sac, was rapid and simultaneous with that of the embryo.

All stages—germination of pollen grains, growth of pollen tubes, development of endosperm, embryo, and seed—proceeded normally in test tubes. During the first 15 days, the rate of growth of endosperm and embryo in the test tube seeds corresponded with the field controls. However, later growth of the artificially fertilized ovules was more vigorous than that in nature.

With further refinements, the techniques may become an important step toward crossing normally incompatible plants, enabling plant breeders to make crosses not now possible.■

Photos below show 7-day-old cultures. White bodies are developing seeds (PN–1630, PN–1631).

At work at the botanical laboratory, University of Delhi (PN–1632).

DIAGNOSTIC CRITERION HELPS IDENTIFY

RICE BLAST RACES

PLANT BREEDERS in several countries are cooperating in efforts to develop varieties of rice with resistance to rice blast disease.

International cooperation speeds the breeding work by making available a pool of information about the many races of this global disease caused by the fungus *Piricularia oryzae*, and about the sources of resistance in breeding stock.

For years, breeding efforts have been hampered by lack of an international criterion for diagnosing the specific races.

Now, there is such a criterion. It was recommended in 1965 after 3 years of experiments in a U.S.-Japan cooperative study. As a result of that study, 8 varieties of rice were selected as the new international differential varieties, called reaction indictators, to identify known races of rice blast. This study also divided the pathogenic races of the rice blast fungus into 8 international groups—IA to IH—to serve as a common language for the same races having different numbers or names in different countries.

ARS scientists who worked on this project are plant pathologists J. G. Atkins, Beaumont, Tex., and A. L. Robert and agronomist C. R. Adair.

Adair, of Beltsville, Md., was also the sponsoring scientist for international research on rice blast conducted under USDA Public Law 480 grants to India and Taiwan.

At the Taiwan Agricultural Research Institute, Taipei, 50 rice strains from various countries, including the United States, were tested with 27 races of blast fungus. This work led to development of a method of detecting susceptibility in very young plants, thus eliminating a long testing period until the plants mature. Taiwan scientists also found 4 varieties that are highly resistant to 18 of the 27 races tested; this germ plasm has been sent to ARS researchers for use in breeding programs.

Indian scientists at the Central Rice Research Institute, Cuttack, determined that 3 varieties are resistant to all Indian races so far identified. These varieties are Te-tep, Tadukah, and Zenith. ARS plant breeders have done some crossbreeding with the first 2 zarieties. Zenith, a U.S. medium grain variety, is resistant to 7 pathogenic races of *P. oryzae* presently known in the Western Hemisphere—all except those in the International B group.

The IB group is particularly virulent; half of the 8 selected international differentials in the U.S.–Japan study are susceptible to most of its 6 known races.

Results from both the Indian and Taiwan P.L. 480 projects have provided ARS scientists with valuable information about how U.S. rice varieties react to many pathogenic races of blast fungus.

In the event alien races should appear in the United States, this information would help our plant breeders develop resistance. The United States, which harvests over 2 million acres of rice a year, is the world's second ranking exporter of this crop.■

ARS DIET SURVEY REVEALS

Need for Improv

HALF OF THE U.S. households had "good" diets and one-fifth had "poor" diets.

These findings were revealed in a survey made by ARS food economists in the spring of 1965. Analysis of the data revealed that low amounts of calcium, ascorbic acid, and vitamin A value are most often responsible when diets are poor.

The study rated diets by comparing amounts of 7 nutrients in household food supplies with recommended allowances established by the Food and Nutrition Board of the National Academy of Sciences-National Research Council as adequate for maintaining good nutrition in healthy persons under current living conditions. The 7 nutrients are protein; two minerals, calcium and iron; and four vitamins, vitamin A value, thiamine, riboflavin, and ascorbic acid (vitamin C).

A comparison of data obtained in 1965 and in a similar 1955 survey shows that 50 percent of the 1965 households had good diets compared to 60 percent in 1955. There was a higher percentage of poor diets in 1965—21 percent compared to 15 percent.

Decreased use of milk and milk products, and vegetables and fruits, the most important sources of calcium, vitamin A value, and ascorbic acid, was chiefly responsible for the decline in the percent of good diets over the 10-year period. The amount of milk, cream, and cheese used per household per week was down 10 percent in 1965 and fruits and vegetables other than potatoes were down 7 percent from the 1955 level. ARS food economists say that "if most households in the United States are to have good diets, awareness of the foods that make up a good diet, a desire to choose these foods, and sufficient money to buy adequate food must become more universal."

The study defines a good diet as one that provides recommended allowances of the 7 nutrients. A poor diet provides less than two-thirds of the recommended allowance for one or more of the nutrients. Two-thirds of the allowance for any nutrient is considered a level below which diets could be nutritionally inadequate for some individuals over an extended period of time. The survey was not designed to determine the presence of malnutrition or hunger.

Diets in 29 percent of the households surveyed in 1965 were between good and poor. Food consumed in these in-between households fell short of recommended allowances for one or more nutrients, but did not drop below the two-thirds level.

The food consumption survey was planned and the data analyzed by ARS food economists. Information was gathered by skilled interviewers who questioned 7,500 families in their homes. These families were a representative sample of U.S. households. The data were classified as farm, rural nonfarm, or urban, and by income groups and regions: West, North Central, Northeast, and South.

Interviewers obtained data only from households in which at least one person had 10 or more meals from home food supplies during the 7 days prior to the interview. They asked about the number of meals eaten at home and away from home by each household member. Information on the food used at home was obtained in sufficient detail for calculation of its nutrient value. These values were computed by the food economists from data in USDA Handbook 8, *Composition of Foods.*

Whether or not a household diet was adequate was determined by relating the total food used by the household to the recommended nutrient allowances for all household members. In rating diets, adjustment was made for food eaten away from home.

About half of the households in each region had diets that failed to meet the recommended allowances for all 7 nutrients. More diets in the North Central and South than in the West and Northeast were low in vitamin A value and ascorbic acid due to less use of vegetables and fruits. The South rated as high as the other regions in calcium levels in spite of lower consumption of milk and cheese. Use of more and different kinds of grain products compensated for less use of dairy products.

In general, about as many urban

d Nutrition

as rural farm and nonfarm households had diets that did not meet recommended allowances for one or more nutrients. Urban families used more dark-green and deep-yellow vegetables and citrus fruits, which gave them more vitamin A value and ascorbic acid. Diets of farm families were higher in calcium, iron, and thiamine due to greater use of milk, cheese, and grain products.

Although a higher percentage of families had good diets as the level of income increased, high income itself did not assure a good diet. Almost one-tenth of the households with incomes of $10,000 and over had poor diets.

At the "under $3,000" income level, more than one-third of the diets were poor.

Data from the USDA food consumption surveys, which show trends in food selection as well as nutritional quality of diets, are used in a number of ways—as a basis for consumer education, food and health programs, and for economic research pertaining to production, marketing, and distribution of food.

Results of a nationwide survey in the mid 1930's gave impetus to the enrichment of white bread and flour with three of the B-vitamins and iron, stimulated nutrition education programs, and indicated a need for a school lunch program. Data from a later survey were used in developing rationing and price control systems during World War II. Food budgets at different cost levels used by family counselors and welfare agencies are based on the USDA survey figures. Results of a 1955 survey indicated need for dietary improvements in spite of relatively high incomes, and provided baseline data for new educational materials and for the pilot food stamp program and other food programs. ■

ST–872–3

ARS's Consumer and Food Economics Research Division has responsibility for periodic assessment of the nation's dietary situation. Reported here are first results of an appraisal of dietary levels based on a nationwide survey of household food consumption made in spring 1965.

NEW GREENHOUSE

. . . STOPS DEVELOPMENT OF VIRUS

A NEWLY DESIGNED greenhouse may be the best structure in existence for producing healthy new growth from virus-diseased plants.

In the experimental greenhouse they developed, ARS researchers halt the development of virus diseases by growing the plants at 100° F.

Once virus development is stopped, subsequent plant growth is healthy. Plant scientists can then remove and root new terminal growth as a source of disease-free stock for increases.

The new greenhouse doubles the heating capacity of ordinary greenhouses. It also operates automatically, closely controlling temperature, humidity, air circulation, and light. These factors have not been controlled so closely before in an entire greenhouse.

Steam from a central power plant heats the greenhouse. Steam is piped in at about 225 degrees F. at 5 pounds per square inch pressure, and is circulated through finned pipes that heat the air.

Temperature is normally between 100° and 101° F. If it rises higher than 104° F., a thermostatically controlled vent in the roof opens and the overheated air escapes. In about two minutes, temperature returns to normal.

Four blowers located under the benches keep temperatures the same throughout the greenhouse. The blowers circulate the total volume of air 15 times a minute.

The air passes heating pipes. Then it is controlled by adjustable louvers fitted between the greenhouse benches and the walls.

The louvers disperse air over a wide angle, and circulation is so even and rapid that the greenhouse does not have to be shaded even in summer. The constant, rapid movement of air wipes excess solar heat off plant leaves.

A fifth blower circulates cool air from a window-type air conditioner. It brings in fresh air to supply carbon dioxide for photosynthesis.

Light is managed to provide 14 hours of daylight. Through June, July and August, artificial light is not necessary. About mid-September however, additional light is required; 1,000 foot-candles of fluorescent light and 200 foot-candles of incandescent light are turned on at the end of the day. This mixture of light simulates the spectrum of sunlight.

Humidity is kept at about 65 percent, but it can be maintained at any predetermined level up to 95 percent. Moisture is supplied primarily by steam injected into the air stream whenever a preset humidistat determines that moisture is needed. Wetting three inches of peat moss on the benches each time the plants are watered provides the remaining moisture. High humidity is needed to prevent disease-free terminal growth from burning and dying.

The greenhouse was developed by research agricultural engineer W. A. Bailey and plant pathologist E. M. Hildebrand. It can be used for most plants and has been instrumental in initiating a sweetpotato seed certification program.

The New Jersey Agricultural Experiment Station appealed to Hildebrand in 1966 for help in getting disease-free stocks of sweetpotato varieties grown in the State. Starting with 5 selections of the Yellow Jersey variety (6 roots of each selection), Hildebrand produced 1,700 disease-free plants in a few months. These plants formed the basis of a seed certification program begun in New Jersey in 1967.■

Dwarf Millet For High Gains

A DWARF GENE could mean higher quality pearl millet forage for cattlemen in the Southeast where this is an important pasture and silage crop.

Tests showed that heifers fed dwarf millet gained 50 percent more per day than those fed normal, tall millet. Fifty percent more leaves per stem on the dwarf millet plants made the difference. The leaves have a higher and more digestible nutrient content than the stems. Because of its higher quality, dwarf millet could improve the high-forage rations fed to finishing steers or lactating cows.

The dwarf gene, d_2, in pearl millet is a simple recessive characteristic. A dwarf line can be formed by introducing the d_2 gene into a normal, tall line through backcrossing.

ARS geneticist G. W. Burton, who isolated the dwarf genotype, also used this backcross method and the d_2 gene to produce the dwarf male-sterile line, Tift 23D. This line, developed at the Georgia Coastal Plain Experiment Station, Tifton, has been released to plant breeders to develop improved millet hybrids for forage. It shows promise of improving millet grain yields in India where plant breeders are also using the line (AGR. RES., July 1967, p. 4).

The millet feeding trial was set up by ARS and Georgia scientists to measure how much the dwarf character might improve forage quality.

Experimental forages were produced from two inbred lines—one dwarf, one tall. These near-isogenic lines—genetically similar except for the dwarf characteristic—were grown, field chopped at boot stage, dehydrated, and fed to Jersey heifers in the trial.

Along with faster gains, dwarf millet also provided a 25 percent advantage in efficiency of gain. Heifers required less dwarf millet per pound of gain than those fed tall millet.■

HARD SEEDS CAN GERMINATE EASIER

INFRARED and radiofrequency electrical treatments appear to be the best means of reducing hard seed content in alfalfa seed lots.

The treatments were conducted by ARS agricultural engineers S. O. Nelson and L. E. Stetson, at Lincoln, Nebraska, and D. W. Works, of the University of Idaho, Moscow.

Hard seeds—also found in other legumes—are viable, but their seedcoats keep out the moisture necessary to start germination quickly. Some agronomists feel that this benefits the grower. If conditions become unfavorable after growers have seeded, they say, hard seeds—germinating later—may still give an acceptable stand.

Other agronomists say that hard seeds contribute little to the stand when plants from quickly germinating seeds survive. They add that seeding times are normally selected when growing conditions are expected to be favorable.

Agronomists, seedsmen, and growers agree on one point: a hard seed content higher than 20 or 25 percent is undesirable. That high a rate of hard seeds in seed lots would force the grower to increase his seeding rate—and his costs—in order to get a good stand.

Some growers prefer a hard seed content of less than 10 percent. Whether 10 or 20 percent is preferred, hard seed percentages of 40 to 50 percent are common, and a safe, practical means of reducing hard seed content would be of real value.

When Nelson, Stetson, and Works conducted tests with the infrared and radiofrequency treatments, they increased germination from the 40- to 60-percent range to the 80- to 90-percent range in 27 different lots of alfalfa seed. The treatments were about equal in their effect on hard seeds.

In earlier studies, Nelson and other ARS scientists showed that germination of hard cottonseed could be substantially increased by electrical methods (AGR. RES., Mar., 1965, p. 15). He and associates Stetson and Works say that infrared or radiofrequency treatment for alfalfa seeds is practical now and would be fairly simple to apply on a large scale.

The electrical treatments also offer an advantage over mechanical scarification, a method often used to reduce hard seed content. This abrasive process is damaging to seeds and germination suffers if seeds are held over until the next season. Electrically treated seeds suffer no damage and can be stored for several years.■

A batch dryer and a flat bottom conventional grain bin for the aeration cooling phase. Processed corn is stored in granary in background (PN–1633).

EASILY ADAPTABLE TO EQUIPMENT

HIGHER VOLUMES WITH DRYERATION PROCESS

OPERATORS OF COUNTRY grain elevators have been hard pressed to handle the volume of high-moisture shelled corn delivered by farmers harvesting with corn combines.

A grain-drying process called dryeration may help solve this problem. The process increases the capacity of equipment and offers less hazard of lowered grain quality than conventional methods.

Farmers are rapidly shifting from pickers to corn combines, which can strip and field-shell up to 5,000 bushels a day. But the grain must be dried immediately to avoid spoilage. In contrast, ear corn harvested by conventional picker goes from field to crib; shelling and drying can be done later when convenient.

Designed to meet growing harvest-time demands, the dryeration process combines heated air drying and delayed aeration cooling. It is adaptable to either continuous-flow or batch dryers.

In recent ARS tests, the cooling section at the bottom of a tower-type, continuous-flow-dryer was converted and added to the drying section so that the entire column could be used for drying. The conversion almost doubled the dryer's capacity. Similarly, dryeration eliminates the 30 to 45 minutes of cooling time required in batch dryers, in which the same bin is alternately used for drying and cooling.

No cooling is done in the dryer in this process. Corn is removed to a supplemental bin and allowed to temper before aeration cooling is started.

In the conventional method, heated air is passed through the corn until a desired moisture level is reached. Then corn is immediately cooled by forced ventilation of outdoor air. This method causes internal stresses and development of cracks in the kernels, making them brittle. Brittle

kernels are more susceptible to damage and breakage: consequently, corn quality is lowered.

G. H. Foster, originator of the process, and R. A. Thompson, both ARS agricultural engineers, conducted extensive tests to determine the most suitable dryeration procedures. The research was cooperative with the Purdue University Agricultural Experiment Station, Lafayette, Ind. The engineers compared dryeration and conventional methods for reducing moisture in fresh-shelled corn from 25 to 14 percent.

Tests showed that kernel breakage in samples dried by dryeration was almost 80 percent less than damage in conventionally dried corn. Dryeration increased drying efficiency by 15 to 23 percent. The gain in efficiency results from better utilization of the hot air in the dryer, optimum use of residual heat in the corn leaving the dryer, and reduction of the moisture that is most difficult to remove through aeration cooling.

Wet corn was dried at temperatures of 190°, 240° and 290° F. Airflow rates for cooling the corn ranged from 0.2 to 1.0 cubic feet per minute per bushel, after tempering periods of 2, 4, 8, and 12 hours.

Best results were obtained when the corn was heated to 140° F. (using a 240° F. heat source), allowed to temper for 8 hours, and then cooled with forced air moving at 0.5 c.f.m. per bushel.

When hot corn was cooled with an upward airflow of less than 0.5 c.f.m. per bushel, excessive moisture condensed on the bin roof and either dropped back on the corn or ran down the bin sidewalls. The moisture caused serious molding to develop on surface layers. The problem was easily resolved by moving and mixing the wetted corn with the dry.■

REVERSE OSMOSIS MAY SOLVE WHEY DISPOSAL PROBLEM

Reverse osmosis, best known as a method of obtaining fresh water from sea water, may help small-volume cheese plants solve the pressing problem of how to dispose of whey.

Fourteen billion pounds of whey—almost two-thirds of the whey produced each year in this country as a waste product of cheese-making—are thrown out annually. Many states have outlawed dumping of this pollutant into waterways. The alternative is concentrating and then drying whey, but existing commercial methods are too expensive for small-volume plants.

An economically feasible solution, ARS research indicates, is to remove 75 to 80 percent of the whey water by reverse osmosis and ship the concentrate to larger plants for drying.

In normal osmosis, two fluids of different concentrations are separated by a semipermeable membrane. The less concentrated solution flows through the membrane into the more concentrated solution until an equilibrium is reached. This is the way nutrients used by the human body enter the bloodstream.

Applying sufficient pressure to the concentrated solution, however, will force flow in the opposite direction. This is reverse osmosis. In the case of whey, the water is forced out through a plastic membrane $^{1}/_{10}$ micron thick. (A micron is 1-thousandth of 1 millimeter.)

Besides eliminating a serious disposal and pollution problem, there is the possibility of separating whey into usable constituents through reverse osmosis. It might be possible, for example, to separate lactose—the only sugar produced by mammals. It is used in dietary foods and pharmaceutical products.

The U.S. cheese industry has the potential for producing 1.4 billion pounds of dried whey a year, with a value of about $140 million.

Whey contains half the solids of milk and is rich in vitamins, amino acids, lactose, and soluble proteins. Dried whey mixed with soybean powder is being tested in India as a baby food. Dried whey has a growing market in bakery products, candy, ice popsicles, and cheese and cream sauces (AGR. RES., Aug. 1967, p. 3).

Cheese plants now concentrate whey in costly vacuum evaporators. Reverse osmosis, unlike evaporation, does not require heating which often affects whey flavor.

Several problems involved in reverse osmosis of whey still challenge researchers, such as clogging of membranes with precipitated solids. Sanitation practices must be perfected because bacteria grow readily in whey.

Scientists are also interested in using reverse osmosis to convert maple sap into sirup, to dehydrate certain foods, and to purify and reclaim waste water.

Food technologist F. E. McDonough conducted the tests in Washington, D.C. Judging by preliminary results of the pilot study, he feels concentration by reverse osmosis should be practical in 1 to 3 years for plants producing as little as 15,000 pounds of cheese each year.■

NEW CONTENT STUDY CONDUCTED

AMINO ACIDS NOT AS HIGH AS BELIEVED

PRELIMINARY STUDIES indicate that the amount of two amino acids—phenylalanine and tyrosine—may not be as high in some foods as previously believed.

This possibility came to light when ARS nutritionists began assembling information from published research findings and from unpublished sources in response to an urgent demand for more information on the amounts of the two amino acids in vegetables and fruits.

Amino acids essential for growth and development can be amply provided by foods in an ordinary diet. However, some individuals are born with a defect in ability to metabolize one or more amino acids. In these cases the intake of the amino acid involved must be restricted to no more than the amount essential for growth and development. As dietary control is of utmost importance, it becomes essential to have reliable data on the content of amino acids in foods—especially in foods having relatively little protein.

The search for information on amino acids is part of a program to revise USDA's Home Economics Report No. 4, "Amino Acid Content of Foods." The revised work will include data for as many as possible of the 18 amino acids commonly found in our foods. The first section to be updated will be the one dealing with vegetables and fruits, because these foods are of special importance in the diets of children with congenital disorders of amino acid metabolism requiring controlled intakes of one or more of the amino acids.

Many vegetables and most fruits have considerably less phenylalanine than the amounts estimated by the old rule of thumb, that is, when estimated as 5 percent of the protein. More recent studies indicate that these calculated phenylalanine values are reasonably satisfactory for most foods of animal origin, and for most cereals, dry legumes, and nuts. Values calculated in this way may also be fairly good estimates for potatoes, sweetpotatoes and for fresh vegetables that are immature seeds, such as sweet corn, peas, cowpeas, lima beans, and other shelled beans. However, the few available studies on dark-green leafy vegetables, such as kale, spinach, and turnip greens, indicate that phenylalanine makes up only about 4 percent of their protein. The protein in most other vegetables and fruits contains even less phenylalanine—usually not over 3 percent.

Current best estimates given in a recent study by ARS nutritionists, M. A. McCarthy, M. L. Orr, and B. K. Watt, should be good news for individuals who are severely limited in the amount they can take of either or both of these amino acids. On the basis of this new information covering 24 kinds of vegetables and 20 kinds of fruits—including values for more than one form of several—more variety and larger amounts of low protein fruits and vegetables can now be permitted in these controlled diets than in the past. Information is summarized as grams of these amino acids present in 100 grams of food and in various designated household measures.

Studies being planned in a number of laboratories should provide urgently needed additional information on the nitrogen and amino acid content of foods. Among fruits and vegetables the analysis of apples, apricots, bananas, oranges, carrots, potatoes, squash, and tomatoes would be especially useful.■

(*PN–1635*)

DRAIN TILES . . . formed by firing soil

CERAMIC TILE is manufactured in a kiln by applying intense heat to clay after molding. Could mole drain lines be formed in place in fields by similarly using heat to fuse the inside surface of openings bored in clay soil? An ARS scientist believes so.

Geologist E. E. Haskell, Jr., tested the idea in Panoche clay loam soil of California's San Joaquin Valley.

Haskell bored a hole, 2½ inches in diameter and 8 feet long, in saturated soil. Then he applied a high-intensity oxygen and acetylene gas flame, moving the torch back and forth through the bore hole for about 30 minutes. The surrounding soil concentrated the heat—in effect, served as a kiln. Photo (PN–1634) shows results.

Firing the clay produced a thin glaze on the surface of the opening. Behind the glaze, a brick-like structure (bisque) about one-fourth inch thick was formed by the heat. The soil remained wet less than one inch from the glazed surface.

The glaze and bisque cracked during cooling because contraction is not uniform in a soil of varied composition. But the cracks would allow water to flow into the drain line from the surrounding soil.

Haskell says many problems must be solved before formed-in-place drain lines become a reality. Among these are determining suitable soils, finding an economical way of boring the holes, designing heating equipment, and selecting the best source of heat.

But Haskell believes that fusing a soil surface with heat may have additional applications in water conservation. Heat might be used for sealing irrigation ditches and earth dams to prevent seepage. Or an impenetrable surface might be produced by heat on the catchment area of a water-harvesting system. But for these purposes cracking would need to be eliminated or closed by applying a sealant.■

Leaves No Residue

Sprays of 2,4-D to control witchweed in the infested areas of North and South Carolina are producing no harmful accumulations of residues in the soil or plants.

Witchweed, a parasitic plant that sucks the life from corn, sorghum, and other grass plants, was discovered in the Carolinas in 1956. ARS and the affected States have since cooperated in confining witchweed to a relatively small area. Within the infested area, they have used the herbicide 2,4-D to help control the weed.

In two series of tests at the ARS Witchweed Laboratory, Whiteville, N.C., plant pest control specialists Marion Langston, R. E. Eplee, and P. F. Sand have monitored 2,4-D residues on Lakeland sandy soil, which is similar to soil throughout the infested areas.

Beginning in 1961, they approximated actual field treatments by applying 2,4-D at the rate of 1 pound per acre in a test plot. A study of samples taken from the test soil in November and June at depths of 0–3 inches, 3–12 inches, and 12–24 inches indicates that 2,4-D virtually disappears over winter.

The second series of tests was begun in 1964 to study the effects of extremely heavy applications. Each year the scientists made 5 or 6 applications of 2,4-D in 1 pound per acre increments. Soil samples were taken after each treatment. Test results over the years have shown no significant accumulation of the herbicide.

ARS monitoring on the effects of heavy applications of 2,4-D will continue as long as the control program is in operation.■

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New ARS lab at Columbia, Mo., looking north. Greenhouses with insectary are in left foreground. Main lab building is in right foreground (PN–1634).

New Biological Control of Insects Lab Is Dedicated

ARS recently dedicated a new laboratory for research on nonchemical control of insects.

The new facility, called the Biological Control of Insects Research Laboratory, is located on the University of Missouri's Columbia campus. ARS scientists will cooperate with the University on research and educational programs of mutual interest.

The new lab is the only one of its kind in the Midwest. Its scientists will determine if various Midwestern environmental conditions are suitable for the release of promising insect predators and parasites from other regions. Research on this approach to pest control has been concentrated at two ARS laboratories in California and New Jersey and at the California Agricultural Experiment Station. Most of the explorations for new insect predators and parasites are directed from ARS laboratories in Italy, France, and Argentina.

Although not yet fully staffed, the new laboratory is already studying the potential for biological control of insects that attack cabbage and other cole crops.

By July 1968, five million tiny wasps, called *Trichogramma*, will be produced daily. These will be tested locally against the cabbage butterfly. ARS scientists elsewhere will also test the wasps on codling moth, cotton bollworm, and sugarcane borer. The wasps are harmless to man.

Scientists also have begun a study of natural enemies of armyworms, cutworms, and horn flies.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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